roofing-slate production of the United States. Virginia was the only state whose output showed an increase. Milling slate, including slate used for blackboards, school slates, electrical work, table tops, and sanitary and other structural work, decreased from $1,714,414 in 1913 to $$1,545,955 in 1914. There was an increase in the material sold for blackboards and a decrease in school slates and other mill stock.

THE United States Geological Survey has just issued, as Water-supply paper 358, a report on the water resources of the Rio Grande basin from 1888 to 1913, by Robert Follansbee and H. J. Dean. Systematic study of run-off in the Rio Grande basin was begun by the federal government near Embudo, New Mexico, soon after the passage of the act of October 2, 1888, which authorized the organization of the irrigation survey under the direction of the United States Geological Survey. A camp of instruction for hydrographers was established near Embudo, and at this camp and the gaging station near by the methods of stream measurements now in general use were systematized. In the spring of 1889 additional stations were established on the Rio Grande near Del Norte, Colo., and El Paso, Texas. From this beginning the work of measuring the waters of the Rio Grande basin has been expanded not only by the Geological Survey acting alone, but by the survey in cooperation with the American section of the International Water Commission and the state engineers of Colorado and New Mexico. At the end of September, 1913, records had been obtained at 93 gaging stations. The report contains not only all data concerning stream flow in the Rio Grande basin collected by the survey and cooperating parties but also records furnished by individuals connected with private interests. Since 1909 the state engineer of Colorado has cooperated in the maintenance of the stations in Colorado. From 1907 to 1912 the work in New Mexico was carried on under the immediate supervision of the territorial engineer. During the latter part of 1912 a cooperative agreement was made with the state engineer.

UNIVERSITY AND EDUCATIONAL NEWS

MR. JAMES J. HILL has given $125,000 to Harvard University to endow a professorship of transportation in the Graduate School of Business Administration.

A TRUST fund of $100,000, the proceeds of which are to be divided between the William Pepper Clinical Laboratory of Medicine and the Latin and Greek department, is bequeathed to the University of Pennsylvania under the will of Samuel Dickson, of Philadelphia.

THE Hahnemann Medical College of San Francisco has offered to convey all its property to the University of California, and has proposed to cease separate instruction. Instead two professorships are to be maintained in the University of California Medical School in homeopathic materia medica and in homeopathic therapeutics, the financial provision therefore to be made, for the next two years, by the homeopaths. The instruction in homeopathic materia medica and homeopathic therapeutics will be offered as elective courses. In all other respects students wishing eventually to become homeopathic practitioners will receive exactly the same instruction in the University of California Medical School as all of its other students.

DR. FRANK THILLY, professor of philosophy, has been elected dean of the College of Arts and Sciences, Cornell University, for a term of two years. He was nominated by the faculty and was elected by the trustees at the board's meeting on June 15. He succeeds Professor E. L. Nichols, whose term has expired and who will spend next year in the far east.

DR. BAILEY WILLIS, of the U. S. Geological Survey, Washington, D. C., has been appointed head professor of geology in the Leland Stanford Junior University, filling the vacancy left in this department when Dr. John C. Branner became president of the university. Professor Willis will take up his new duties with the opening of the school year in September.

DR. W. F. R. PHILLIPS, of the University of Alabama, has accepted the chair of anatomy in the Medical College of South Carolina.

Dr. Albert H. Wright, instructor in neurology and vertebrate zoology in Cornell University, has been promoted to be assistant professor of zoology. Arthur A. Allen has been appointed assistant professor of ornithology in the college of agriculture.

DISCUSSION AND CORRESPONDENCE

ELEMENTARY MECHANICS

To the Editor of Science: Four or five years ago we received several letters from our physics friends criticizing our discussion of Newton's laws of motion. One of these criticisms related to our use of the term "unbalanced force." If action and reaction are always equal and opposite they must balance each other, as some people seem to think, or in other words, it must be impossible for a body to be acted upon by an unbalanced force!

We swear by the God of Simplicity! A mule pulls forward on a cart with a force A, and the ground pulls backwards on the cart with a force B. If A and B are equal, the cart is acted on by balanced forces; but if either is greater than the other, the forces are unbalanced and the cart gains or loses velocity. The force with which the mule pulls *on the cart* and the necessarily equal and opposite force with which the cart pulls backwards *on the mule* can not balance each other because they do not act on the same body. You can not keep a thief from setting your pocketbook in motion by hanging tenaciously to a lamp post! and yet the ideas of action and reaction which are soberly held by many of our most pretentious teachers of mechanics mean exactly that when reduced to intelligible terms! Some of those who make a mess of action and reaction are like the Missouri purist who would wish to invent a fancy way of saying that Iowa is *north* of Missouri in order to avoid a verbal battle with the man from Iowa who insists that Missouri is *south* of Iowa.

Another matter has entered into the recent discussion of elementary mechanics in Science, namely, the question as to the fundamental equations of dynamics. Professor Huntington[1] is certainly wrong in claiming that the fundamental facts of Newton's second law are covered by the statement that the acceleration of a given body is proportional to the accelerating force.

It is very important to distinguish clearly between the conventional content and the experimental content of Newton's second law of motion concerning the accelerating effect of an unbalanced force. There are two[2] more or less distinct points of view concerning this matter as follows:

1. We may adopt the stretch of a spring as the basis of force measurement. Then to a fair degree of accuracy *experiment shows* that the acceleration of a given body is proportional to the accelerating force; and *experiment also shows* that the acceleration which is produced by a given unbalanced force is inversely proportional to the mass of the accelerated body. In this statement the mass of the body is understood to be the result obtained by weighing a body on a balance scale.

2. We may agree to consider one force as

[1] Science, February 5, 1915.

[2] Some physicists are inclined to a third point of view which makes nearly the entire content of Newton's second law conventional. The ratio of two forces is defined as the ratio of the accelerations produced by the respective forces when they are made to act, one at a time, on a given body (experiment only can show that the ratio so measured is the same whatever body be used); and the ratio of the masses of two bodies is defined as the inverse ratio of the accelerations produced in the respective bodies by a given force (experiment only can show that the ratio so measured is the same whatever force be used). From this point of view it is considered as a discovery that the ordinary centuries-old balance scale can be used to measure materials!

Consider any operation which always yields the same numerical result when applied to a given batch of sugar, but which yields a different numerical result when applied to a part of the batch. Such a numerical result can be used as a measure of the quantity of sugar, and if any such operation yields an invariant numerical result of extreme precision that particular operation should be taken as the quantitative definition of mass, if mass is to mean quantity of matter; but we should never forget that the adoption of any particular measure is essentially arbitrary.